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Some Obſervations and Experiments about Vitriol, *tending to find out the Nature of that Subſtance, and to give further Light in the Inquiry after the Principles and Properties of other Minerals: Communicated by a Fellow of the* R. Society, *who maketh Uſe of Chymiſtry chiefly as ſubſervient to Phyſiology.*

V*ITRIOL* is by the Spagirical Tribe reputed one of the chief Pillars of Medicine and Alchimy, and is indeed endowed with many excellent and truly admirable Properties, being employed by Nature in her moſt Curious Mineral Operations. Tis it ſelf one of the moſt noble and uſeful

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Productions, and therefore deſerves our ſpecial Conſideration. I do not pretend to render a Mechanical Account of its Generation, nor a Hiſtory of all that may be performed by its Mediation in Medicine, or Chymiſtry; my Deſign is only to furniſh inquiſitive Perſons with ſome Obſervations and Experiments, which will probably enable them more eaſily to inveſtigate the Nature of this *Protean* Subſtance, as alſo afford ſome further Light unto them in their Inquiry after the Principles and Properties of other Minerals. *Vitriol* is of ſeveral Kinds, being, for Colour, White, Yellow, Green, or Blue; uſually of the Two laſt mentioned: And is made either of Mineral Waters boiled up to a convenient Conſiſtence, then ſet to Chryſtallize, or extracted by common Water out of Earths impregnated therewith. 'Tis alſo afforded by many Sorts of Stones, commonly called *Pyrites* and *Marcaſites*, which expoſed ſome Months unto Aerial Influences, are reſolved into Powder, and the Saline Part diſſolved in Rain, or other Water, then boiled and ſet to ſhoot, yields Store of Vitriol, eſpecially with the Addition of Copper, or Iron. It is often aſſociated with Earth and Stones, wherein Mettals are contained; and with many natural Recrements of Mettals, ſuch as *Miſy*, *Sory*, *Chalcitis*, from which 'tis uſually ſeparable by the common Method with Water, ſometimes not to be extricated until the Mineral be firſt calcined, or burnt. It is alſo frequently found pure and perfect in the Caverns of the Earth, being an Efflorescence of ſeveral Minerals; and this is accounted by all Naturaliſts the beſt, both for Medicinal and Spagirical Uſes. *Laſtly*, It is copiouſly contained in common Mineral Sulphur, as I ſhall anon fully evince. Vitriol uſually accompanying moſt Mettals and Minerals, many do apprehend it is always one of their component Principles, at leaſt a neceſſary Cauſe of, or Agent in, their Production; which, if meant of the Acidity, or Saline Part of Vitriol, ſeems highly probable; as I ſhall manifeſt at large in the enſuing Diſcourſe. But firſt, I think it expedient to examine what are the conſtituent Parts of Vitriol, whereby we ſhall be better enabled to judge of its Nature and Properties.

Vitriol conſiſts of inſipid Phlegm, Earth, or Oker, ſome Mettal, Mineral Sulphur, an acid Salt, or Spirit, together with

with ſome ſmall Portion of the Votatile Aerial Salt.

That it contains *Water* needs no great Proof, ſince no Saline Subſtance can criſtallize without it; and Diſtillation will convince any Perſon, that it exceeds in Quantity any of the other Principles.

The *Earth*, or *Oker*, may be thus ſeparated: Diſſolve Vitriol in fair Water, immediately a yellow Powder will ſeparate, and in a ſhort Time ſubſide: The greater the Quantity of Water imployed, the more Oker precipitates: The weaker the *Lixivium*, the leſs able to ſupport Bodies more ponderous than common Water: And the lighter the Water (as if diſtilled Rain-Water, or Phlegm of vinous Spirits) the more earthy Parts ſubſide, upon the ſame Hydroſtatical Principle I juſt now mentioned. I have above twenty Times repeated this Diſſolution, ſeconded by Filtration and Coagulation, and each Time ſeparated ſome Quantity of this Earth, and am perſwaded, had I long continued the Operation, the Succeſs would have been the ſame; only I obſerved the Quantity ſeparated each time ſenſibly to diminiſh: And *Baſilius Valentinus* aſſures, that at length the Vitriol will let fall no more Sediment, and that then it is the Subject of moſt noble Operations by him particularized; which they, who have Leiſure and Confidence in his ſpecious Promiſes, may do well to try. I have found a more eaſie and expedite Way of effecting this Separation, which may be of great Uſe to them who work on Vitriol, much abbreviate their Labour, and conſiderably leſſen their Expence.

Take a good Quantity of the common *Dantzick*, or *Hungarian* Vitriol, having powdered it, put it into a ſlender Cucurbite, place it in Water, keep under it an equal conſtant Fire three or four Days: The Vitriol without Additament will become fluid, as if diſſolved in Water, and the Oker with moſt of the Metalline Parts, with the groſs Sulphur, will ſubſide, and become a hard Cake at the Bottom, the Vitriol being fluid above it, which in the cold again Cryſtallizeth, excepting a ſmall Quantity of Liquamen of the ſame Nature with that we ſhall hereafter mention: This repeated once or twice, the Vitriol attains unto a high Degree of Purity, and is eaſily capable of many Alterations, whereunto it was ſubject before this purification. This operation will not ſucceed in a dry digeſtion; I mean, Aſhes, Sand, Filings of Iron, Steel, open Fire, or even flame of Lamps, whether fed with Oil or Spirit of Wine. This Earth may alſo be obtained in a great proportion, though in another form, if after a long and intenſe Calcination the Vitriol is freed from its remaining Salt by frequent ablutions with warm Water: The far greateſt part of this dulcified Colcothar is inſipid Earth with ſome ſmall proportion of Mettal. The ſame may be precipitated by Salt of Tartar, or any other Alcalies, or filings of *Zink*, or other immature Minerals, out of a ſolution of Vitriol in common Water: It being alſo ſeparated from Metalline and Saline parts, by a method I ſhall hereafter mention, there remains a great quantity of an inſipid ſubſtance nearly reſembling burnt Allom: Beſides, whereas *Salt*, *Nitre*, *&c.* require in diſtillation a large quantity of Earthy ſubſtance to disjoyn the Saline parts, and prevent fuſion; Vitriol and Allom need it not; an unqueſtionable proof, that Earthy parts abound therein.

That Vitriol contains *Sulphur*, is evinced by the Sulphureous ſmell it emits in diſtillation, eſpecially if urgent with a ſtrong fire from the beginning, and the Spirit thus drawn being rectified, the Liquor, which firſt ariſes, hath a highly Sulphureous ſmell, as hath alſo that we ſhall hereafter mention, diſtilled from Vitriol deprived of its Matallick Parts. The *Colcothar* dulcified, or Metallick parts precipitated by an Alcali, or immature Mineral, ſublimed with Sal Armoniack, an inflammable Sulphur may be many ways ſeparated both from the ſublimate and *Caput mortuum*. The common Oil of Vitriol digeſted on Antimony, then diſtilled, yields a much greater quantity of Sulphur, than would have been produced, had any other acid Liquor been imployed; and the ſame Oil of Vitriol digeſted with Spirit of Wine, and diſtilled, yields an Oil, and at the latter end ſtore of Sulphureous Inflammable Flowers.

As for the *Acid* Saline Principle, I ſuppoſe no perſon who hath taſted the Spirit of Vitriol, and that abuſively, called, its Oil, will queſtion its abounding in that ſubject.

Some add unto the Principles, we have enumerated, the

Salt

Salt to be ſeparated from the *Colcothar* after diſtillation; which I omit, Eperience having learned me, that it is of the ſame nature with the former, only ſomewhat more fixed; and if the Spirit be cohobated from the *Caput mortuum*, it is with the reſt volatilized, nothing remaining beſides Metal and inſipid Earth.

The *Saline* Principle being that whereon I intend chiefly to inſiſt, I ſhall enquire whence it derives its Original? what ſubject it doth moſt reſemble? or with what 'tis moſt nearly allied? In order to the reſolution of theſe Enquiries, and the confirmation of certain Propoſitions, hereafter to be mentioned, I ſhall premiſe ſome Experiments, made many years ago, which perhaps may give no leſs ſatisfaction unto many of our Experimental Philoſophers, than they afforded me, when I firſt made mine.

I took four or five Gallons of the Vitriolate water, which was conveyed, by artificial Channels at *Deptford*, from the beds of *Pyrites* or *Marcaſites* into the great Ciſtern. I diſtilled therefrom in glaſs Veſſels two thirds of inſipid water; letting the Glaſſes cool, the water let fall a Vitriol of a lovely, dilute Colour, (whether green or bluiſh I do not remember,) together with a great quantity of that yellow Sediment which we formerly called *Oker*: Then evaporating a third part of the remaining Liquor, I received more Vitriol of a paler colour than the former, and *Oker* as before, though leſs: The fifth time this operation was repeated, inſtead of Vitriol it afforded a yellow, and ever after a white, Salt, which did differ exceedingly from Vitriol, not only in colour, but alſo taſte; being fiery and pungent; did partake little of that abominable rough aſtringent ſmack which is peculiar to Vitriol. It was almoſt unctuous, like Salt of *Tartar*; made the hands ſoft and ſupple, cleanſing like a *Sapo*; whereas common Vitriol renders them rough, and harſh: Being diſſolved in water, it appeared to the very Eye very fatty and oleaginous.

Among many other appearances ſufficiently remarkable, in this laſt liquor and Salt, I ſhall only mention theſe few;

1. *Obſ.* From five pounds and a half of *Lixivium*, I received four Pounds of this fiery white Salt, beſides half a

pound

pound of *liquamen*, which remained fluid, and would not coagulate. I do the rather mention this; for that is one of the moſt eminent Inſtances, I ever met withal, of ſo great a quantity of Salt kept fluid in the cold by ſo ſmall a quantity of water.

2. The remaining *Liquamen* was very fiery, acidly pungent, and extreamly ponderous; no whit inferiour, in my opinon, in any of theſe reſpects, to common Oil of Vitriol; it ſeeming to me ſtrange, and unuſual, that ſo ſtrong a Liquor ſhould be obtained without any conſiderable Degree of Fire.

3. This *Liquamen* being expoſed unto the Air, ſoon *attracted* (if our Criticks will permit me to uſe ſuch an Expreſſion,) double its quantity of Moiſture. I cannot recollect, that I did ever obſerve any fluid Body, which approached near unto it for this Property; though I am not ignorant, that all Corroſive Saline Liquors will borrow conſiderably from their neighbouring Element. And I remember, that divers eminent Chymiſts have delivered ſeveral Preparations of Vitriol, which derive Moiſture from the Moon more or leſs, according unto her ſeveral *Phaſes*; which I am perſwaded is a meer Dream, having ſeen little hitherto that ſhould perſwade me, any of the Planets do influence otherwiſe than by Heat and Light. And I always obſerved this *Liquamen* to acquire more or leſs Moiſture, according to the Conſtitution of the Seaſon, riſing ſenſibly in moiſt Weather, and little in dry, without any reſpect unto the Moon, or other Planets; which I can the more poſitively determine, having for ſeveral Months made accurate Obſervations with conveniently ſhaped Glaſſes. But to return from whence we digreſſed;

The white Salt laſt mentioned was diſtilled in a Sand-furnace, and the far greater part came over in the form of a Spirit highly acid, eſpecially that which came laſt in ſmall Drops. This Liquor rectified in a very tall Body, immediately upon the approach of the ſmalleſt Degree of Heat a volatile Sulphureous Spirit did ariſe, clear as Rock-water almoſt, nay I think altogether inſipid; yet the ſmell ſo ſubtle and penetrating, that 'twas inſupportable: And ſuch it continued many years, not letting fall any ſediment, and thereby loſing its ſtrength, as doth the volatile Spirits made out of

Common Vitriol. The Spirit which remained after the ſeparation of the more Volatile, was in all reſpects like that of *London* Vitriol; only ſeemed more gratefully acid, and might, like it, be ſeparated into Spirit, and Oil, corruptly ſo ſtil'd.

Vitriol freed, as is before declared, from its Earthy and Metallick Parts, by *Zink*, or other imperfect Minerals, is much of the ſame nature, and yields its Spirit in Sand, as this we have now mention'd: Is alſo White, and more unctuous; hath a Grain more like Nitre than Vitriol; as hath alſo the *Goſlar* Vitriol, which is White, and comparatively unctuous, becauſe it hath little Mettal, and leſs Mineral-Sulphur than the Common; whoſe Mettaline Part detains the Saline, and will not diſmiſs it until long urged by a very intenſe degree of heat. What remained in the Retort, after this diſtillation, was not red or purple, like the *Caput mortuum* of Common Vitriol, but white, light, and ſpongious, like burnt Allom, and altogether as inſipid; although, after it was ſomtime expos'd unto the Air, it received many ſtrange Impreſſions and Alterations; which, though very remarkable, I omit, as not anſwering my preſent Deſign, which is to enquire, whence the Saline Principle in Vitriol proceeds, and how it comes to be ſo compounded? But firſt, I cannot but take Notice of the great Affinity that is between *Vitriol*, *Allom*, and *Mineral Sulphur*; the Saline Principle, which is in each of them by far the Chief, both in Quantity and Energy, having one Nature and the ſame Properties; although in the laſt clog'd with a ſmall Portion of Sulphur. For notwithſtanding what is commonly received, I ſhall clearly prove, that the Body of Common Sulphur is a Vitriolate Salt, the very ſame with that, which is ſeparable from Common Vitriol; and that the Sulphureous Parts are not only leſs copious, but inconſiderable for bulk, compared with the Saline, which are ſincere Vitriol, not differing from the Common; only that doth not ſo much abound in Metallick and Earthy Particles.

So far the Author for this time, having been unexpectedly interrupted to proceed in this Deſign, which he hath promiſed to finiſh for the next Opportunity.